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TEXAS AGRICULTURAL EXPERIMENT STATION

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DIVISION OF CHEMISTRY

Digestibility by Chickens of the Constituents of the Nitrogen-Free Extract of Feeds

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
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The digestibility by chickens of the sugars, starch, pentosans, and residual nitrogen-free extract in 24 feeds were studied. In 122 individual tests, the sugars and starches were highly digested. The residual nitrogen-free extract and especially the pentosans, have a lower digestibility. Chickens digest sugars and starches to the same extent as sheep, but have only half as much power to digest pentosans. This is further confirmation of the fact that chickens have only a low power to utilize fibrous materials or roughages.

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BULLETIN NO. 437 NOVEMBER, 1931

DIGESTIBILITY BY CHICKENS OF THE CONSTITUENTS OF THE NITROGEN-FREE EXTRACT OF FEEDS

By G. S. FRAPS

The ordinary digestion experiment deals with the digestibility of the protein, fat, crude fiber, and nitrogen-free extract. Each of these is a group, containing a number of related chemical compounds, but varying in character in different kinds of feeds. The nitrogen-free extract contains sugars, starches, pentosans, and other compounds. The crude fiber contains celluloses, pentosans, lignins, and other substances.

A study of the digestibility of the constituents of the nitrogen-free extract of feeds by chickens was made in connection with digestion experiments on these animals. Similar work was done in connection with digestion experiments on sheep, already reported (Bulletin 418). These studies were undertaken in the hope that they would throw some light on the differences in the feeding values of feeding stuffs.

METHOD OF WORK

The material used was secured in the digestion experiments with chickens, reported in Bulletin 372. The feeds were usually fed with a little alfalfa hay, as described in the Bulletin referred to, but in some cases other feeds were also fed in the ration.

The sugars were extracted by 50 per cent alcohol and estimated by the Munson and Walker method. Starch was made soluble by diastase, in material previously extracted with ether and alcohol and the analysis was completed in the usual way. Total pentosans were estimated by conversion into furfural and precipitation with phloroglucinol. Pentosans in crude fiber were estimated in the crude fiber prepared from a 3-gram sample of the feed. The total pentosans less those in the crude fiber gives these in the nitrogen-free extract. The reducing sugars, polysaccharoses or non-reducing sugars, starch, and pentosans in the nitrogen-free extract, were added together and the sum subtracted from the total nitrogen-free extract. The difference is here called the residual nitrogen-free extract.

COMPOSITION OF FEEDS

The ordinary analyses of the feeds are given in Bulletin 372. Table 1 contains the sugars, starches, and other constituents of the feeds used in the digestion experiments here reported. Feeds of known high-feeding value are characterized by a high content of sugars and starch or a high content of protein. Chicken feeds on the whole are higher in sugars

Table 1. Composition of feeds

Lab. No.	Name of feed	Reducing sugar	Polysaccharoses	Starch	Pentosans in NFE	Residual NFE	Total pentosans	Pentosans in C. F.
20715	Alfalfa DE P 142	2.30	2.33	1.20	9.73	25.92	12.97	3.24
20714	Alfalfa DE P 142	2.20	2.40	1.20	9.09	25.63	12.62	3.53
22193	Alfalfa	2.28	1.09	1.83	10.68	21.10	15.01	4.33
22820	Alfalfa	1.69	1.20	1.10	9.11	25.34	13.69	4.58
19813	Alfalfa meal DE P 3	2.33	.86	1.69	11.93	21.96	17.14	5.21
20568	Alfalfa meal DE P 15	1.99	.67	1.03	7.10	24.61	18.13	11.03
20820	Barley DE P 18	1.42	1.03	40.40	9.51	7.60	10.51	1.00
21958	Barley DE P 26	.75	1.05	46.10	8.67	11.59	9.26	0.59
22186	Barley DE P 33	.78	1.19	47.15	9.10	11.52	10.18	1.08
24286	Barley DE P 52	1.16	1.15	38.21	9.03	17.88	9.79	.76
25789	Barley DE P 188	.36	1.41	47.04	7.89	13.90	8.55	.56
22246	Japanese buckwheat DE P 36	.19	.96	47.56	5.67	7.21	7.90	2.23
19466	Corn DE P 3	.57	1.26	55.96	6.07	9.00	6.20	.13
19868	Mexican corn DE P 7	.62	1.62	51.86	6.28	9.21	6.28	0
19918	Corn meal DE P 8	.49	1.08	64.03	3.19	5.71	3.19	0
20567	Corn meal DE P 15	.38	.42	61.48	2.21	12.91	2.38	.17
22765	Corn meal DE P 38	.84	.94	59.32	3.15	13.18	3.15	0
25992	Corn meal DE P 65	.50	.22	61.40	3.63	7.04	3.79	.16
23922	Corn meal	.35	1.42	58.89	4.47	8.87	4.61	.19
26290	Corn meal DE P 66	.14	1.56	63.44	2.80	6.30	2.96	.16
20016	43% protein cottonseed meal	.11	5.60	0	6.95	11.04	7.90	.95
25993	Cottonseed meal DE P 65	.89	.38	0	10.00	15.74	11.71	1.71
23040	Cowpeas DE P 45	.09	5.80	22.88	4.33	25.92	4.84	.57
22123	Darso DE P 29	.41	.46	56.18	3.68	9.92	3.68	0
24782	Darso DE. P. 60	.60	.30	54.98	3.28	14.08	3.43	.15
19851	Darso seed DE P 6	.55	.57	59.78	3.59	7.01	3.91	.32
19830	Spur feterita DE P 5	.83	.54	54.15	2.86	12.53	3.03	.17
21766	Spur feterita DE P 22	.92	.59	51.40	3.25	11.42	3.51	.26
22145	Spur feterita DE P 30	.46	.69	55.53	2.99	9.98	3.22	.23
24711	Spur feterita DE P 59	.65	.31	55.31	3.44	10.69	3.63	.19
24807	Dwarf feterita DE P 61	.63	.44	54.37	3.16	10.87	3.35	.19
22114	Standard blackhull kafir DE P 28	.63	.38	53.93	3.89	12.72	4.15	.26
24854	Standard blackhull kafir DE P 63	.48	.69	57.48	4.12	8.44	4.35	.23
22196	Millet DE P 34	.83	.36	46.80	5.17	9.17	6.52	1.35
19823	Dwarf yellow milo DE P 4	.48	.91	61.21	3.99	7.65	4.16	.17
21825	Dwarf yellow milo DE P 24	.66	1.05	56.08	3.97	10.87	4.12	.15
22168	Dwarf yellow milo DE P 32	.60	.76	59.40	4.16	7.44	4.38	.22
22909	Dwarf yellow milo DE P 45	.64	.77	59.05	3.74	8.55	3.93	.19
23160	Milo	.77	.67	62.20	3.89	3.68	4.09	.20
24414	Milo DE P 55	.47	.07	57.64	5.03	8.42	5.30	.27
24846	Dwarf yellow milo DE P 62	.56	.76	58.66	3.62	6.83	3.78	.16

19416	Oats	.98	1.02	38.50	10.91	9.58	12.31	1.40
19426	Rolled oats DE P 2	.08	1.39	55.30	3.67	4.74	3.67	0
24655	Oats DE P 57	.69	.61	28.46	11.09	19.67	12.50	1.41
20102	Rice DE P 12	.86	.57	51.81	4.03	9.47	5.63	0
20540	Rice polish	.26	.02	68.65	1.75	10.38	1.75	0
20843	Rice DE P 20	.41	.61	68.83	2.29	4.41	2.29	0
23087	Rice bran DE P 173	2.20	5.39	8.00	9.14	13.18	10.94	1.80
23088	Rice bran DE P 173	2.30	5.20	8.43	9.05	11.27	10.85	1.80
23087–8	Rice bran DE P 173	2.25	5.30	8.22	9.10	12.23	10.90	1.80
23115	Rice polish DE P 174	1.28	5.04	38.13	3.48	7.99	3.68	.20
23116	Rice polish DE P 174	1.35	4.98	38.08	3.89	7.12	4.09	.20
23115–6	Rice polish DE P 174	1.52	5.01	38.11	3.69	7.55	3.89	.20
22218	Rye DE P 20	1.56	3.39	50.35	9.63	7.03	9.88	.25
21787	Sargo (sumac) seed DE P 23	.75	.68	55.10	3.70	11.52	3.85	.15
21969	Shallu DE P 27	.42	.19	54.98	3.45	8.59	3.45	0
22991	Shallu DE P 44	.62	.89	57.13	3.95	7.55	3.95	0
22257	Soybeans DE P 37	.23	8.26	.85	4.25	8.84	4.61	.36
22161	Sumac sorghum DE P 31	.55	.61	51.95	4.15	14.17	4.35	.20
22964	Sumac sargo DE P 43	0.49	.60	57.10	3.79	11.16	4.04	.25
24681	Sumac sorghum DE P 58	.54	.56	51.03	3.56	16.74	3.76	.20
20713	Tankage DE P 17	.06	0	0	.27	2.43	.27	0
20015	Mediterranean wheat DE P 10	.36	1.79	50.62	6.99	8.99	7.22	.23
21930	Wheat DE P 25	.66	1.52	49.05	7.83	9.16	8.10	.27
20193	Wheat bran DE P 13	1.74	2.50	15.41	21.23	11.49	22.03	.80
23183	Wheat bran	.79	4.89	15.53	20.24	12.92	20.94	.70
23159	Wheat gray shorts	.83	5.34	35.20	14.03	1.82	14.48	.45
24383	Wheat gray shorts	2.03	4.44	21.33	13.66	16.25	14.09	.43
24384	Wheat gray shorts	1.12	5.32	23.95	12.79	13.10	13.23	.44

Table 2. Average coefficients of digestibility for chickens

Name of feed	No. averaged	Reducing sugar	Polysaccharoses	Starch	Pentosans in NFE	Residual NFE	Total pentosans	Pentosans in C. F.
Alfalfa meal	2	81.8	97.4	63.8	2.1	40.0	16.9	49.2
Barley	10	72.5	88.2	98.5	23.6	60.6	24.4	27.7
Japanese buckwheat	2	97.4	71.9	99.3	44.7	23.0	41.1	30.9
Corn meal	18	92.6	97.3	99.0	52.3	74.6	50.5	22.1
Cottonseed meal	6	47.6	82.9	.....	62.3	64.2	63.0	37.3
Cowpeas	2	0*	99.7	98.7	64.7	98.1	61.3	50.0
Darso	6	89.6	92.1	99.4	59.6	47.0	57.5	34.0
Feterita	10	97.5	94.9	99.1	50.9	60.0	49.9	30.2
Kafir	6	95.8	97.2	99.1	36.0	77.2	35.6	27.9
Millet	2	100.0	98.8	98.6	20.5	61.9	24.7	43.2
Dwarf yellow milo	13	89.5	87.9	99.3	44.3	65.1	42.5	23.0
Rolled oat groats	2	0*	96.4	99.5	80.3	74.7	79.2	0
Whole oats	3	85.1	85.5	97.2	18.0	45.9	20.0	34.3
Whole rice	4	99.0	97.1	99.7	37.8	76.2	44.0	0
Polished rice	4	99.8	79.1	99.3	79.0	98.1	80.7	50.0
Rice bran	4	96.8	96.6	90.8	7.0	9.0	8.7	22.5
Rice polish	2	91.5	93.4	98.5	34.6	29.5	31.0	0
Rye	2	95.5	92.0	98.3	58.0	52.8	57.0	16.0
Shallu	3	91.9	100.0	99.3	39.2	81.2	34.3	33.0
Soy beans	2	50.0*	97.9	.....	60.4	78.3	56.8	13.9
Sumac sorghum	7	89.7	97.7	99.1	53.6	57.5	48.4	27.7
Wheat	4	78.9	93.7	98.8	49.7	77.3	45.5	6.3
Wheat bran	4	76.7	93.6	93.9	26.2	26.6	23.1	25.0
Wheat gray shorts	4	84.9	91.2	94.5	36.6	30.1	36.3	27.7
Average	.....	86.5	92.6	96.5	43.4	58.7	43.0	28.5

*This sample very low in sugar.

and starches than those used for ruminants; that is, the chickens are not able to use roughages, or fodders, which are generally low in sugars and starch.

COEFFICIENTS OF DIGESTIBILITY

The average coefficients of digestibility secured in this work are given in Table 2, while the coefficients secured in the individual experiments are given in Table 4. There are 24 feeds, with 122 individual tests.

The digestibilities of the sugars and starches are high. The reducing sugar of cowpeas, oat groats, and soy beans, has apparently a low digestibility but this was due to the very small percentages present. The residual nitrogen-free extract and the pentosans have low digestibilities. The digestibility of the pentosans is especially low in feeds containing woody material, such as alfalfa meal, whole barley, which contains barley hulls, whole oats, which contains oat hulls, whole rice, which contains rice hulls, wheat bran, and wheat gray shorts. The pentosans of oat groats have a digestibility of 79, while those of whole oats have a digestibility of 20. This is in accordance with the well-known fact that chickens cannot utilize hays or roughages or material containing much crude fiber. The pentosans in the crude fiber have a low digestibility, but the quantity present in some of these feeds is so low that the coefficients of digestibility in some of the tests were quite variable (Table 4). The pentosans in the nitrogen-free extract on an average are digested to the same extent as the total pentosans.

COMPARISON OF DIGESTION BY CHICKENS AND BY SHEEP

A comparison of the digestion of sugars, starches, pentosans, and residual nitrogen-free extract by sheep and by chickens is given in Table 3. On an average, there is little difference between the digestibility of sugars and that of starch, by sheep and by chickens. The residual nitrogen-free extract on an average is digested about 10 per cent less by chickens than by sheep, while the pentosans are digested only about half as much by chickens as by sheep. The differences are greater for pentosans in such feeds as alfalfa meal, whole oats, and rice bran, though it is not so great as might be expected with rough rice and wheat bran.

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Analyses and other work in connection with this Bulletin were done by E. C. Carlyle, J. K. Blum, W. H. Walker, and other members of the staff.

Table 3. Coefficients of digestibility for chickens compared with those for sheep

	No. of experiments averaged	Reducing sugar	Polysaccharoses	Starch	Pentosans in NFE	Residual NFE	Total pentosans	Pentosans in C. F.
Alfalfa hay, sheep	16	97	98	86	56	69	53	41
Alfalfa meal, chicken	2	82	97	64	2	40	17	49
Cottonseed meal, sheep	5	73	99	.....	95	53	94	79
Cottonseed meal, chicken	6	48	83	.....	62	64	63	37
Corn, Argentine, sheep	1	100	100	93	97	50	91	23
Corn meal, chicken	18	93	97	99	52	75	51	22
Feterita seed, sheep	1	100	100	99	91	73	85	50
Feterita, chicken	10	98	95	99	51	60	50	30
Kafir chops, sheep	1	95	100	97	89	0	75	.....
Kafir, chicken	6	96	97	99	36	77	36	28
Milo, sheep	4	90	64	99	90	77	79	33
Dwarf yellow milo, chicken	13	90	88	99	44	65	42	23
Oats, sheep	2	89	98	100	74	54	68	46
Whole oats, chicken	3	85	86	97	18	46	20	34
Rice bran, sheep	2	95	100	100	60	38	47	2
Rice bran, chicken	4	97	97	91	7	9	9	23
Rice polish, sheep	3	98	99	100	88	44	76	19
Rice polish, chicken	2	91	93	99	35	29	31	0
Rough rice, sheep	3	88	100	99	34	.....	52	.....
Whole rice, chicken	4	99	97	100	38	76	44	0
Wheat, whole, chicken	1	98	100	99	96	95	95	86
Wheat, chicken	4	79	94	99	50	77	45	6
Wheat bran, sheep	1	91	15	26	22	79	26	100
Wheat bran, chicken	4	77	94	94	26	27	23	25
Wheat gray shorts, sheep	2	96	99	100	85	40	85	46
Wheat gray shorts, chicken	4	85	91	94	37	30	36	28
Average (sheep)	.....	93	90	92	75	56	71	48
Average (chicken)	.....	86	93	95	35	52	36	23

Table 4. Individual coefficients of digestibility for chickens for each experiment

		Chicken No.	Reducing sugar	Polysaccharoses	Starch	Pentosans in NFE	Residual NFE	Total pentosans	Pentosans in C. F.
19813	Alfalfa meal DE 9	17	75.2	100.0	47.6	2.4	33.2	9.7	24.9
		3	88.4	94.7	80.0	1.7	46.8	24.1	73.5
	Average	.....	81.8	97.4	63.8	2.1	40.0	16.9	49.2
20820	Barley DE 18	17	84.2	85.3	97.9	6.5	31.6	8.0	21.6
		22	87.6	92.3	98.5	20.0	44.0	22.2	43.2
21958	Barley DE 26	3	53.3	94.3	98.4	31.6	60.9	30.2	9.3
		17	54.7	88.1	97.9	26.6	71.1	26.0	17.8
22186	Barley DE 33	3	75.0	87.8	100.0	25.9	59.4	28.8	53.2
		17	100.0	97.5	100.0	18.5	64.4	21.5	46.8
24286	Barley DE 52	17	82.3	94.8	97.6	34.4	69.6	35.1	43.4
		22	87.9	97.8	97.7	33.8	69.0	34.0	36.2
25789	Barley DE 64	22	86.1	74.5	97.1	19.5	79.9	19.4	3.6
		2023	13.5	70.1	100.0	18.6	55.8	18.4	1.8
	Average	.....	72.5	88.2	98.5	23.6	60.6	24.4	27.7
22246	Japanese buckwheat DE 36	3	94.7	93.8	98.6	50.8	45.4	46.4	35.2
		17	100.0	50.0	100.0	38.5	.6	35.9	26.7
	Average	.....	97.4	71.9	99.3	44.7	23.0	41.1	30.9
19466	Corn chops DE 3	2	95.8	95.2	99.4	58.9	37.9	56.3	0
		4	87.4	97.8	99.4	78.9	38.5	75.2	0
19868	Mexican corn chops DE 7	17	87.7	100.0	99.3	45.0	65.1	37.2	0
		22	97.4	98.5	99.4	42.3	76.0	39.1	0
19868	Corn meal DE 8	22	95.5	98.8	99.6	84.1	96.0	84.0	0
		3	96.1	98.3	99.5	81.3	91.9	80.5	0
20567	Corn meal DE 17	.....	91.0	92.1	99.4	65.1	86.4	85.5	100.0
		22	86.8	92.1	99.3	71.6	96.8	91.8	100.0
22765	Corn meal DE 38	17	94.1	96.3	98.9	44.4	77.8	41.6	0
		22	98.8	97.3	98.2	48.1	.....	45.2	0
22765	Corn meal DE 40	17	94.0	98.7	99.6	45.0	74.6	40.5	0
		22	92.5	99.3	100.0	41.3	54.8	34.7	.....
22765	Corn meal DE 41	17	94.0	96.0	99.6	45.4	89.1	38.9	0
		22	85.8	99.3	99.1	45.2	73.3	38.3	0
22765	Corn meal DE 51	17	88.1	93.6	95.3	14.8	73.8	10.5	100.0
		22	91.1	98.9	.....	.....	.....	33.7	.....
26182	Corn meal DE 67	17	95.5	100.0	98.6	38.4	88.1	36.9	7.7
		20	95.5	99.6	98.6	38.8	73.8	39.2	46.2
	Average	.....	92.6	97.3	99.0	52.3	74.6	50.5	22.1

Table 4. Individual coefficients of digestibility for chickens for each experiment—Continued.

		Chicken No.	Reducing sugar	Polysaccharoses	Starch	Pentosans in NFE	Residual NFE	Total pentosans	Pentosans in C. F.
20016	43% protein cottonseed meal DE11	22	0	100.0	0	100.0	100.0	84.9	42.5
		3	0	96.2	0	0	58.5	27.3	38.9
25993	Cottonseed meal DE 65	22	94.4	80.0	.....	.....	61.4	.....	25.0
		2023	100.0	33.3	.....	86.8	61.4	76.9	42.7
26291	Cottonseed meal DE 66	17	72.7	96.4	.....	.....	46.2	.....	.....
		22	18.2	91.3	.....	.....	57.3	.....	.....
	Average	.....	47.6	82.9	0	62.3	64.2	63.0	37.3
23040	Cowpeas DE 45	17	0	99.3	97.3	29.3	96.1	22.6	0
		22	0	100.0	100.0	100.0	100.0	100.0	100.0
	Average	.....	0	99.7	98.7	64.7	98.1	61.3	50.0
22123	Darso DE 29	3	97.1	100.0	99.7	55.9	36.7	50.4	0
		17	97.1	96.5	100.0	60.2	54.8	55.9	0
24782	Darso DE 60	17	82.8	65.6	99.1	63.3	54.5	66.9	100.0
		22	90.0	100.0	99.3	55.6	52.9	51.3	0
19851	Darso DE 6	17	83.3	96.5	99.0	63.5	45.8	62.8	55.0
		3	87.0	93.7	99.3	58.9	37.2	58.0	48.8
	Average	.....	89.6	92.1	99.4	59.6	47.0	57.5	34.0
19830	(Spur) Feterita DE 5	22	98.7	94.6	99.0	35.9	83.1	36.5	48.9
		3	100.0	94.6	98.9	24.8	73.2	23.9	8.5
21766	(Spur) Feterita DE 22	3	99.6	100.0	99.9	64.8	67.7	63.8	50.8
		17	99.6	100.0	99.1	46.9	57.6	45.3	26.2
22145	(Spur) Feterita DE 30	17	100.0	100.0	98.8	58.0	56.0	55.3	17.4
		22	97.8	100.0	98.7	58.7	54.5	56.1	21.7
24711	(Spur) Feterita DE 59	17	94.8	100.0	99.5	63.3	57.7	62.3	.....
		22	98.5	100.0	98.9	56.8	43.2	60.9	0
24807	(Dwarf) Feterita DE 61	17	89.4	74.2	98.7	50.2	46.0	51.4	67.9
		22	96.8	85.2	99.1	49.5	61.0	43.7	.....
	Average	.....	97.5	94.9	99.1	50.9	60.0	49.9	30.2
22114	Whole dwarf kafir DE 21	3	98.1	100.0	98.8	36.4	85.7	37.5	53.9
		17	98.7	100.0	98.7	21.2	90.3	21.6	27.7
22114	Blackhull kafir DE 28	3	100.0	100.0	99.4	44.5	81.6	42.9	17.3
		17	100.0	100.0	99.8	48.5	83.3	48.0	40.4
24854	Blackhull kafir DE 63	20	83.3	91.3	99.1	31.7	61.1	31.2	21.7
		22	94.8	92.0	98.8	33.9	61.0	32.5	6.5
	Average	.....	95.8	97.2	99.1	36.0	77.2	35.6	27.9

22196	Millet DE 34	3	100.0	97.7	98.2	29.5	62.4	22.5	[illegible]
		17	100.0	100.0	99.0	11.5	61.5	26.9	86.4
	Average		100.0	98.8	98.6	20.5	61.9	24.7	43.2
19823	Dwarf yellow milo DE 4	1	87.5	98.2	99.7	46.2	82.4	47.0	69.8
		3	77.5	99.6	99.0	39.1	100.0	39.5	51.2
21825	Dwarf yellow milo DE 24	3	90.3	100.0	100.0	53.3	80.2	51.5	5.3
		17	83.0	100.0	100.0	40.7	80.0	30.1	0
22168	Dwarf yellow milo DE 32	17	100.0	100.0	99.8	50.5	61.8	49.4	29.6
		22	99.2	100.0	100.0	46.0	58.6	45.3	34.1
22909	Dwarf yellow milo DE 42	17	76.6	94.8	99.1	38.6	62.9	36.5	0
23160	Milo DE 49	17	87.0	99.3	98.9	57.2	78.0	58.4	82.5
		22	92.9	86.6	99.5	41.7	0	39.5	0
24414	Milo DE 55	17	87.2	64.3	99.0	49.8	59.5	47.6	5.6
		22	96.8	0	99.1	51.5	53.4	49.6	14.8
24846	Dwarf yellow milo DE 62	20	92.0	100.0	97.5	26.8	40.6	24.5	.....
		22	93.8	100.0	99.4	34.4	89.3	33.2	6.3
	Average		89.5	87.9	99.3	44.3	65.1	42.5	23.0
19426	Rolled oat groats DE 2	1	0	95.4	99.8	84.2	78.6	83.1	0
		2	0	97.5	99.1	76.4	70.9	75.3	0
	Average		0	96.4	99.5	80.3	74.7	79.2	0
19416	Whole oats DE 1	1	71.9	85.3	97.9	22.5	15.7	23.0	24.1
24655	Whole oats DE 57	17	87.7	90.2	96.7	16.3	63.0	16.5	18.1
		22	95.7	81.1	97.1	15.3	59.0	20.4	60.6
	Average		85.1	85.5	97.2	18.0	45.9	20.0	34.3
20102	Whole Japan rice DE 12	17	97.0	95.5	99.4	11.6	86.7	29.9	0
		3	100.0	93.0	100.0	16.8	41.3	33.4	0
20843	Whole rice DE 20	1	99.0	100.0	99.7	55.0	89.3	50.1	0
		2	100.0	100.0	99.7	68.1	87.6	62.7	0
	Average		99.0	97.1	99.7	37.8	76.2	44.0	0
20540	Polished rice DE 14	17	100.0	50.0	97.9	83.9	95.2	84.7	0
		3	100.0	66.7	99.4	98.0	97.0	99.8	0
20577	Polished rice DE 16	17	100.0	100.0	100.0	67.6	100.0	90.8	100.0
		3	99.3	99.6	100.0	66.4	100.0	47.7	100.0
	Average		99.8	79.1	99.3	79.0	98.1	80.7	50.0
23087–8	Rice bran DE 46	17	95.1	100.0	84.9	10.6	18.0	13.5	28.6
		22	98.0	94.0	90.5	.4	9.0	3.7	20.0
23087–8	Rice bran DE 53	17	96.7	96.7	96.3	10.0	0	10.7	14.4
		22	97.6	95.6	91.6	.....	.....	6.9	26.9
	Average		96.8	96.6	90.8	7.0	9.0	8.7	22.5

Table 4. Individual coefficients of digestibility for chickens for each experiment—Continued

		Chicken No.	Reducing sugar	Polysaccharoses	Starch	Pentosans in NFE	Residual NFE	Total pentosans	Pentosans in C. F.
23115–6	Rice polish DE 47	17	87.5	98.6	97.2	33.1	22.0	29.7	0
		22	95.4	88.2	99.8	36.0	37.0	32.2	0
	Average		91.5	93.4	98.5	34.6	29.5	31.0	0
22218	Rye, whole DE 35	3	96.8	91.6	98.2	64.6	58.8	63.6	24.0
		17	94.2	92.3	98.4	51.4	46.7	50.4	8.0
	Average		95.5	92.0	98.3	58.0	52.8	57.0	16.0
21969	Shallu DE 27	3	94.3	100.0	99.4	45.0	86.2	40.8	0
		17	100.0	100.0	99.5	41.8	76.7	37.2	0
22991	Shallu DE 44	17	81.5	100.0	98.9	30.8	80.6	24.9	100.0
	Average		91.9	100.0	99.3	39.2	81.2	34.3	33.0
22257	Soy beans DE 37	3	6.5	97.8	0	60.2	94.3	56.0	5.6
		17	93.5	97.9	0	60.6	62.3	57.6	22.2
	Average		50.0	97.9	0	60.4	78.3	56.8	13.9
21787	Sumac sargo DE 23	3	90.4	100.0	99.1	49.6	48.7	47.5	0
		17	90.4	100.0	99.3	52.5	47.9	49.5	0
22161	Sumac sargo DE 31	3	100.0	100.0	98.3	74.0	70.5	45.5	12.5
		17	99.1	100.0	99.9	51.9	52.0	48.6	0
22964	Sumac sargo DE 43	17	67.4	100.0	99.3	56.7	31.1	57.6	70.0
24681	Sumac sargo DE 58	17	93.5	83.9	98.8	43.5	75.1	42.9	27.5
		22	87.0	100.0	99.2	46.6	77.5	47.3	60.0
	Average		89.7	97.7	99.1	53.6	57.5	48.4	27.7
20015	Wheat DE 10	17	72.1	94.9	98.9	42.6	84.4	38.7	0
		22	65.1	94.4	98.7	54.4	78.3	45.0	0
21930	Wheat DE 25	3	84.2	95.8	99.9	60.7	71.9	58.8	25.0
		17	93.9	89.7	97.9	41.0	74.6	39.3	0
	Average		78.9	93.7	98.8	49.7	77.3	45.5	6.3
20193	Wheat bran DE 13	17	80.4	93.0	84.5	44.3	29.7	34.1	.....
		3	95.2	100.0	99.0	46.5	54.5	43.3	.....
23183	Wheat bran DE 50	17	72.2	91.1	99.6	6.0	0	6.5	19.3
		22	58.9	90.3	92.5	7.9	22.2	8.7	30.7
	Average		76.7	93.6	93.9	26.2	26.6	23.1	25.0
23159	Wheat gray shorts DE 48	17	85.5	91.0	99.1	44.9	0	44.2	20.0
		22	81.9	88.7	99.5	40.5	0	39.4	5.6
24383	Wheat gray shorts DE 54	17	88.3	92.8	86.2	29.8	43.0	30.0	37.5
		22	83.9	92.1	89.1	31.0	77.3	31.5	47.7

SUMMARY

The digestibility of sugars, starches, pentosans, and residual nitrogen-free extract was determined by a number of digestion experiments on 24 feeds.

Sugars and starches are highly digested by chickens. Pentosans and residual nitrogen-free extract have low digestibility.

Pentosans are digested to a less extent in roughages or roughage materials, than in concentrates.

Chickens on an average digest sugars and starches to the same extent and residual nitrogen-free extract a little less than sheep, but they digest pentosans on an average only half as much.